

7 BEST PRACTICES

Adaptive Traffic Signal Systems

GRESHAM, OREGON

WHAT IS IT?

Adaptive traffic signal systems measure traffic conditions in the street in real time and constantly adjust the signal timing based on real-time data. They have been shown to reduce vehicle delay, travel time, and the number of stops. Adaptive traffic signal systems have been used since the early 1970s; however, their implementation has been relatively slow-paced in the U.S.

There are several different adaptive signal systems available, but four of the most prominent systems include Sydney Coordinated Adaptive Traffic System (SCATS), Split Cycle and Offset Optimization Tool (SCOOT), ACS Lite, and InSync. SCATS and SCOOT were developed through government research and sponsorship in Australia and the UK in the 1970s and are the two of the most widely implemented adaptive programs throughout the world today. The ACS Lite adaptive signal system was developed by the Federal Highway Administration (FHWA) in the 2000s and four demonstration installations were completed in 2006. InSync was developed in 2009 and implemented in several cities in the U.S. in 2010. SCATS, SCOOT, and ACS Lite can all be implemented with transit signal priority (TSP), and InSync is currently working on upgrading the system to support TSP.

The cities of Sydney and Brisbane, Australia have implemented transit signal priority with the SCATS adaptive signal system, and the Georgia Regional Transportation Authority is currently managing



In Gresham, Oregon, travel time on the Burnside corridor decreased with the introduction of adaptive traffic signal systems.

Source: Portland Ground, <http://www.portlandground.com/archives/2005/12/>

design and construction of the Atlanta Smart Corridor Project, which will include implementation of transit signal priority with the SCATS adaptive signal system. Additionally, the City of Bellevue, WA completed a needs assessment and evaluation of adaptive traffic signal systems in 2010, and has installed the SCATS system in the Factoria Boulevard corridor. An adaptive signal system is also being installed in downtown

Bellevue, and it will be implemented with transit signal priority. The City of Portland, OR will also be implementing an adaptive traffic signal system with transit signal priority in the Powell Boulevard corridor in May 2011.

WHY DO IT?

Adaptive systems decrease travel times through corridors and improve travel time reliability over conventional signal timing systems during even the highest peak traffic flows. Adaptive systems are especially effective in cases where traffic volumes are variable or have the potential to change during special events or reroutes due to closures of adjacent streets or highways. Transit systems benefit from the reduced travel times and increased travel time reliability when operating within an area or corridor with adaptive traffic signal control.

An evaluation of the existing city infrastructure as well as an assessment of the needs and requirements of a new signal system should be completed prior to implementation of an adaptive traffic signal system.

Some example criteria for evaluating whether and what type of adaptive traffic signal should be implemented include:

- What type of signal controllers and system (central system or field master) are being used?
- What type of transit signal priority is being used?
- What is the proximity of the area/corridor to freeways?
- Is the peak period variable in terms of duration and start/finish time?
- Are there special event generators in proximity to the site? How frequently are they used?

HOW WELL DOES IT WORK?

As of 2010, there are no known case studies documenting the effectiveness of adaptive signal systems specifically with respect to transit operations. However, there have been evaluations completed that document the effectiveness of adaptive signal systems in terms of general traffic operations. Transit vehicles would see the same benefits as other vehicles in the corridor from the improvements in travel time, reliability, and reduction of stops.

CONVENTIONAL VS. ADAPTIVE SIGNAL SYSTEMS

Conventional Signal Timing

- **Actuated-Uncoordinated “Free” Signal Timing:** Each intersection in a corridor responds to its own need with no regard to traffic operations at adjacent intersections. The traffic signal controller adjusts the amount of time served to each phase of the intersection based on the number of vehicles detected by detector loops or video detection at that intersection.
- **Coordinated Signal Timing with Time-of-Day Plans:** Signal timing along a corridor or within a network is coordinated between controlled base upon static signal timing plans that are developed based on a sample of the average traffic volumes for the times of the week when the plans will be developed. The time-of-day plans result in a cycle length common to the group of coordinated signals, and offset in the cycle starting points between adjacent signals, a sequence of phases, and an allocation of cycle time (splits) for each phase at each signal.

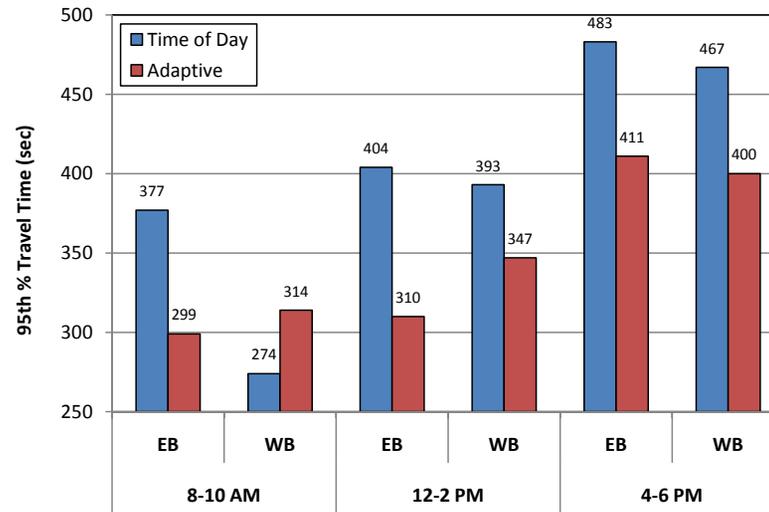
Adaptive Signal Timing

- **Adaptive Signal Timing:** Adaptive signal control systems continually refine the timings at every intersection within a corridor or network, cycle-by-cycle, as traffic conditions change. Adaptive systems monitor traffic conditions using vehicle detectors for all approaches, and often for all movements, of the intersections within the corridor. These systems adjust the signal timing based on the real-time traffic flow in the corridor.

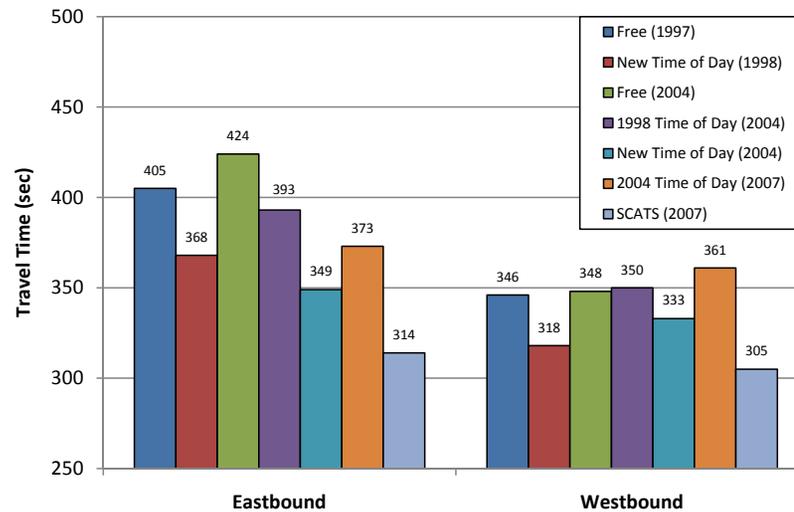
Case Study: Gresham, Oregon— Effectiveness of Adaptive Signals

The Burnside corridor is a five-lane major arterial in Gresham, OR that carries approximately 38,000 vehicles per day through the city’s growing commercial and retail district. Prior to implementing the SCATS adaptive traffic signal system at 11 intersections in 2007, traffic signal time-of-day plans had been updated regularly for 10 years.

The performance of the SCATS system was compared to the newly-optimized time-of-day plans and historical records. The adaptive system showed a significant improvement over the time-of-day plan operations, and travel times on the corridor have been reduced to the lowest recorded levels. The adjacent charts show the difference in travel times during the highest traffic flows (95% flows) that occur in the corridor during the morning, midday, and afternoon peak periods for traffic volumes. During the periods with the highest traffic volumes, the travel time through the corridor with the adaptive signal timing was significantly less than the travel time through the corridor with the time-of-day plans for all but the westbound direction in the AM peak period. Not only does the SCATS system result in a reduction in travel time through the corridor over the average of the peak period, it also results in a reduction in travel time when traffic volumes in the system are highest.



Travel time on the Burnside corridor decreased with the introduction of SCATS in 2007.



Adaptive traffic signal systems resulted in significant reductions in travel time in Gresham, OR.

Source: DKS Associates

